



Cable Modems and DSL: Broadband Internet Access for Residential Customers

By JERRY A. HAUSMAN, J. GREGORY SIDAK, AND HAL J. SINGER*

To date, most residential customers to the Internet have used dial-up modems with a top speed of about 56.6 kbps [kilobits per second]. In the past two years broadband access has become available via cable modems offered by the local unregulated cable provider and via digital subscriber lines (DSL) offered by the local regulated telephone company (the incumbent local exchange carrier [ILEC]) and competitors who resell DSL using the ILEC facilities. Cable modems and DSL offer access speeds about 10–30 times higher than dial-up access and are termed “broadband Internet access.” Although Federal Communication Commission (FCC) regulation requires ILEC’s to sell the use of their facilities to competitors at below-cost prices, no regulation of cable companies has occurred. This outcome is curious given that cable companies have a significantly greater incentive to distort competition as a result of their unregulated monopoly profits from their cable operations. This asymmetric regulation by the FCC has led to the “open-access” debate. The open-access debate involves the question about whether the cable providers should be required to provide access to competing broadband Internet service providers (ISP’s) or whether cable providers can use exclusive contracts with their affiliated ISP’s.

Here, we consider the economic incentives and actions of the providers of broadband access with respect to limiting the usage of broadband access, including the potential competitive effects for cable television, a sector of the economy where, to date, system operators have been able to exercise significant market power.¹

* Department of Economics, Massachusetts Institute of Technology, 50 Memorial Drive, Cambridge, MA 02142, American Enterprise Institute for Public Policy Research, and Criterion Economics, respectively. Please send correspondence to J. Hausman (e-mail: jhausman@mit.edu).

¹ By “market power” we use the antitrust definition of charging above the competitive price for a significant period of time.

Currently, AT&T is the nation’s largest cable multiple system operator (MSO). AT&T also controls Excite@Home Corp., the largest provider of residential broadband service, with over 2.3 million subscribers in November 2000. Excite@Home has exclusive contract rights to provide residential broadband service over the cable facilities of its three principal equity holders (AT&T, Comcast Corporation, and Cox Communications, Inc.), which collectively account for over 35 percent of the nation’s cable subscribers. Similarly, Time-Warner is the second-largest cable provider and has an exclusive contract with Road Runner, the second-largest provider of broadband Internet service, with 1.1 million subscribers. The competitive implication of the exclusive arrangements are straightforward: to access an alternative broadband ISP instead of the ISP affiliated with the cable provider, a user of broadband cable access has to “pay twice.”

Alternative sources of delivery for video programming provide a competitive threat to the significant market power of the cable industry. Previously, the cable industry has unsuccessfully attempted to control access through control of satellite delivery of video programming, the first alternative medium for multichannel video programming. This attempted strategy was blocked by the Department of Justice (DOJ). Control of broadband Internet delivery of video programming, the second alternative medium for multichannel video programming, arises from cable-provider control of cable broadband access. Internet “video streaming” competes and will compete even more in the future with video programming offered by cable systems, satellite companies, and television broadcasters.

I. Description of the Broadband Internet Market

A. Qualitative Description

Many of the services supported by broadband connections are not available through narrow-

band connections. The demand for applications that can be supported only by high-bandwidth connections suggests that the product markets for narrowband and broadband access are distinct. Functionalities that are only supported by broadband connections include real-time video programming, on-demand video, customized music and video libraries, home networking, real-time radio programming, interactive multiplayer gaming, high-speed telecommuting, and interactive advertising and e-commerce.

B. Quantitative Analysis

To answer the question of whether the price of narrowband Internet access constrains the price of broadband Internet access, it is useful to note that the data demonstrate wide variation in second-telephone-line prices across different regulatory jurisdictions. Because most narrowband Internet users cannot tie up their first line, the price of a second line is a good estimate for the incremental price of narrowband access. It is also useful to note that the price of broadband Internet access, as measured by the price of cable modem service, remains relatively constant across these different jurisdictions. Hence, one can infer that narrowband Internet access is unlikely to constrain the price of broadband Internet access.

The question of market definition can be tested empirically. If it can be shown that narrowband Internet access prices (including the access charge plus the price of a second telephone line) do not constrain broadband Internet access prices, then a hypothetical monopoly provider of broadband Internet access could more easily sustain a 5-percent price increase above the competitive market price; hence, the existence of a separate broadband Internet access market is more plausible using the government's *Merger Guideline* analysis.

To conduct an econometric analysis, we gathered price data in August 1999 from 41 states and 59 multiple system operators where Excite@Home and Road Runner were then currently being sold. For cable subscribers, the broadband access price varied from \$34.95 per month to \$64.95 month. We also considered the installation fee, which varied from \$50 to \$150. We amortized this installation fee over different periods in various regression specifications, depending on the predicted churn rate for broad-

band customers. For narrowband Internet access, we collected data from the ILEC's providing service in the areas served by the local cable provider.

Prices for second telephone lines (used, for instance, by many AOL [America OnLine] customers) varied from \$7.70 to \$47.62 per month. Installation costs for a second telephone line varied from \$16.90 to \$55.30. Again we amortized the installation cost for the second telephone line. Given that the "standard" price for the Excite@Home cable service is \$40 per month and the price for second lines for narrowband access varies widely from \$8 to \$48 per month, plus the standard fee which is nationwide for narrowband ISP's (for example, \$21.95 per month for AOL), the data demonstrate that the *Merger Guideline* test for market definition places narrowband Internet access in a separate market from broadband Internet access. The straightforward observation is that narrowband access prices differ by a factor of over 300 percent, while broadband access prices do not vary in any way with these differences. Thus, variations in the price of narrowband access cannot explain the variations in the price of broadband access. Otherwise, when the price of a second telephone line changes from \$48 to \$8 per month, we would expect to observe a decrease in the price for the broadband access service. No significant decrease is found, which demonstrates the existence of separate product markets for antitrust purposes.²

Table 1 shows the regression results, which use the price of broadband access (either Excite@Home or Road Runner) as the left-hand side variable. The price variable is specified in logarithms. The right-hand side variables are an intercept, an indicator variable for Road Runner, a variable for second-telephone-line prices from the ILEC, and variables for population characteristics and density, which could affect demand or cost characteristics of broadband cable.³

² Some narrowband Internet customers do not use a second telephone line. We have also analyzed the data using a weighted average of customers who use a first or second telephone line. The results do not differ significantly.

³ The ILEC price of second-telephone-line service is treated as predetermined in the regression specification because it is set by regulation, not by market forces. Also, a Hausman (1978) specification test did not reject exogeneity.

TABLE 1—REGRESSION RESULTS (DEPENDENT VARIABLE = LOG OF CABLE BROADBAND ACCESS PRICE PLUS AMORTIZED MONTHLY COST OF INSTALLATION)

Variable	Coefficient	SE	t
Intercept	4.86	0.564	8.62
Log price of narrowband access	-0.029	0.033	-0.877
Log population density	0.001	0.010	0.057
Log median household income	-0.028	0.064	-0.433
Percentage of population age 65 and older	-0.006	0.006	-1.16
Percentage of population age 35-54	-0.009	0.009	-0.979
Percentage of population under age 5	-0.016	0.022	-0.757
Road Runner indicator	-0.114	0.014	-8.07
Number of observations:	59		
SER:	0.002		
R ² :	0.600		

Notes: Broadband access price is the log of cable broadband access price plus amortized monthly cost of installation. Narrowband access price is the log of the price of a second telephone line plus second-line fees plus amortization of the installation cost.

The estimated coefficient for the price of narrowband access, as measured by the price of a second line, is essentially zero, -0.029 , which is extremely small and nowhere near statistical significance. Thus, the hypothesis that the price of narrowband access does not affect the price of broadband access (transport) and ISP service is not rejected. Our finding is that lower narrowband access prices do not constrain the prices charged for broadband access. Because the price of AOL is not included in any explanatory variable, its effect is contained in the estimate of the intercept coefficient.

The findings are quite uniform across different specifications corresponding to different definitions and amortization periods for installation costs. The estimated coefficient of the narrowband-access price variable is found to be very small and statistically insignificant across specifications. We find similar results if we limit the sample to Excite@Home MSO's. We estimated an additional specification by including in the regression the median household income and the average population density for the relevant markets. Thus, we conclude that the price of narrowband access does not constrain the price of broadband access. Broadband Internet access is a separate relevant market for competitive analysis and for antitrust purposes.

II. Possible Future Developments

It is possible that at some point in the future new technologies will emerge, or existing technologies will be refined, in such a way that they will compete effectively with cable-based Internet services. However, we believe that, under the current regulatory framework, neither DSL nor satellite-based Internet service will be able to offer close substitutes for cable-based Internet service within the medium-range time horizon. Hence, neither will be able to provide the price-disciplining constraint needed to protect consumer welfare.

The relatively slow deployment of DSL to date has limited its ability to discipline any price increase by a cable-based provider of broadband Internet access. DSL deployment is constrained by technical impediments. DSL is sensitive to the distance that transmissions must travel between the home and central office. DSL does not work (or work well) if the copper segment exceeds approximately 3-3.5 miles (4.84-5.65 km), which encompasses about 25-35 percent of ILEC customers. Also, DSL cannot be provided where digital loop carrier (DLC) technology has been employed, which includes a large part of the southern United States.

Even if DSL providers were to overcome their technological limitations, significant regulatory barriers prevent them from competing effectively against the cable broadband providers. The regional Bell operating companies (RBOC's), which are the primary providers of DSL, operate within an entirely different regulatory environment than their cable competitors. First, the RBOC's are excluded entirely from the core backbone market. Also, the RBOC's face separate-subsidiary requirements that may make it more expensive to provide Internet search engines or content of any kind. Also, the Telecommunications Act requires RBOC's to unbundle their network services at rates below the costs of providing them. The FCC has indicated its policy of extending unbundling requirements to broadband Internet services, which decreases the economic incentives to provide these services.⁴ The asymmetric regulatory treatment of the RBOC's with respect to cable providers prevents DSL from being an

⁴ See Hausman (1997) for a further discussion.

TABLE 2—MARKET-SHARE ESTIMATES MADE BETWEEN
31 MAY 2000 AND 31 DECEMBER 2000

Consultancy	Cable subscribers	DSL subscribers	Relevant date ^a	Cable share (percent)
Yankee Group/Kagan	3,500,000	900,000	31/12/2000	79.5
TeleChoice	3,000,000	1,400,000	29/8/2000	68.2
Forrester Research	2,227,000	869,000	31/5/2000	71.9
Average:				73.2

^a Dates are reported as day/month/year.

57

effective competitor in the broadband Internet-access market for residential customers. Although we do not discuss potential competition from satellites here, we do not believe that they will provide significant constraining competition to cable providers for broadband Internet access in the next few years.

Looking further in the future, one cannot ignore the potential impact of both current- and next-generation wireless Internet access. Third-generation (3G) wireless technology promises to deliver wireless Internet access speeds of up to 2 Mbps to indoor home users and is expected to be implemented in the United States in a few years. However, these possible future technological developments do not have a significant current influence on broadband competition.

III. Competitive Assessment

A. Penetration Levels of Cable Modems and DSL

As we described earlier, broadband Internet services markets are local in nature. Measures of concentration at a local level are not readily available, however, because carriers only provide information on subscribers at the national level in their quarterly financial filings. It is only possible to draw inferences about the *average* local level of concentration based on a nationwide measure of concentration. Table 2 shows several estimates of the market share for cable modems and DSL.

As Table 2 shows, cable's market share was, on average, estimated to be 73.2 percent as of the third quarter of 2000. DSL still lags far behind cable modems and is not closing the gap as quickly as expected: cable's share was 83.6

percent in the third quarter of 1999 (*Cable Datacom News*, August 1999, p. 2). It is important to note two items when considering broadband market share. First, the relevant market for the purpose of our discussion is the residential broadband access market. Because the above numbers include both residential and business sectors, and because cable has little presence in the business sector, the market share for DSL providers is overstated. According to an FCC study released in October 2000, the ratio of cable modems to DSL for "residential and small business high-speed lines" at the end of June 2000 was 2.5 (*FCC News*, 31 October 2000 [table 3]).

Second, the threat of discrimination against unaffiliated broadband conduits or broadband content providers remains with this level of market penetration by cable modems. By discriminating against (downstream) access rivals, the vertically integrated firm can distort competition by forcing broadband customers who demand marquee content to choose cable over other forms of access. By discriminating against (upstream) content rivals, the vertically integrated firm can distort competition by weakening its access rivals' bargaining position with respect to nonaffiliated upstream suppliers.

B. Possible Anticompetitive Strategies by Cable Providers

Full-service broadband providers integrate four inputs of broadband service: (i) broadband content (e.g., streaming video and audio, movies, video conferencing, interactive games), (ii) the aggregation of broadband content and complementary services (e.g., chat rooms, instant messaging) by a broadband portal, (iii) connectivity to the Internet supplied by a broadband Internet service provider, and (iv) high-speed transport from the home to the ISP supplied by a cable provider, telephone company, or other broadband conduit provider.

From these descriptions, there are two anticompetitive strategies that a vertically integrated firm offering both broadband transport and portal services could profitably pursue. First, an integrated provider could engage in *conduit discrimination*, insulating its own conduit from competition by limiting its distribution of affiliated content and services over rival platforms. Conduit discrimination could involve

a range of anticompetitive strategies, from refusing to distribute an affiliated portal over competing conduits to making popular content available only to customers using an affiliated conduit. Second, an integrated provider could engage in *content discrimination*, insulating its own affiliated content from competition by blocking or degrading the quality of outside content. Content discrimination could involve a range of strategies, from blocking outside content entirely to affording preferential caching treatment to affiliated content.

Both of these strategies are potentially costly, but the benefits could outweigh the costs in certain situations. For example, a firm engaging in conduit discrimination will forgo revenues from content distribution over rival platforms. However, there are potentially countervailing benefits, because with conduit discrimination, customers will perceive the cable conduit as more valuable. This, in turn, will increase the demand for cable transport relative to other forms of transport. Hence, a cable broadband provider will engage in conduit (or content) discrimination if the gain from additional access revenues from broadband users offsets the loss in content revenues from narrower distribution. To the extent that cable transport providers compete against DSL and other broadband transport providers, the reduction in revenues from lost customers will be greater.

There are several ways in which a vertically integrated broadband provider can discriminate against unaffiliated content providers. First, it can give preference to an affiliated content provider by caching its content locally. Such preferential treatment ensures that affiliated content can be delivered at faster speeds than unaffiliated content.

Second, a vertically integrated broadband provider can limit the duration of streaming videos of broadcast quality to such an extent that they can never compete against cable programming. Stated more generally, a vertically integrated firm like AT&T can block any competing content that it wants to. Currently, AT&T and other cable providers limit video streaming to less than ten minutes.

Third, a vertically integrated firm such as AT&T or AOL-Time-Warner could impose proprietary standards that would render unaffiliated content useless. The academic literature

on standards and network externalities provides theoretical and empirical support for the conjecture that AT&T could impose proprietary standards that would raise the switching costs for its subscribers and stifle competition in vertically related software markets.

The traditional cable strategy of TCI (AT&T's predecessor) has been to use its market power in the delivery of programming to expand its control over the programming itself. Time-Warner has previously used a similar strategy to limit competition in programming.

IV. Regulatory Review of Open Access

To date, the FCC has imposed no regulatory conditions on the provision of broadband access by cable providers. In considering the merger of AT&T and MediaOne, the FCC acknowledged that the merger could pose anticompetitive threats to emerging markets for broadband Internet services, but "those harms will be avoided if: (a) consumers can choose among various alternative broadband access providers, such as DSL, wireless, and satellite; or (b) unaffiliated ISP's are permitted access to the merged firm's cable network." The FCC was satisfied that a competitive market for broadband access already provided to the former, and the agency was convinced that AT&T had committed itself to providing the latter. With the exception of a small trial in Boulder, Colorado, AT&T has not provided broadband access to unaffiliated ISP's.

The Federal Trade Commission (FTC) and the FCC began their review of the proposed merger of AOL and Time-Warner in the summer of 2000. The FCC has asked AOL and Time-Warner for additional information on "open access" to cable modem platforms. In a response to the FCC request, AOL and Time-Warner promised that they would not discriminate against ISP's and would let multiple ISP's use their cable lines. However, the FTC appears reluctant to accept this guarantee. Instead, it is likely to require the merged AOL-Time-Warner to have at least one unaffiliated ISP signed up before AOL is permitted to deliver service using the Time-Warner cable network. The companies were in talks with the FTC at the time of this writing.

The approach of the FCC is especially curious because it requires ILEC's to provide the

use of DSL facilities at below cost.⁵ If the FCC actually believes that the broadband access market is competitive with cable modems, DSL, and satellite delivery, then no reason exists for the FCC decision in 1999 that required ILEC's to sell the use of their DSL facilities to competitors at below-cost prices. Competition from cable modems would restrain any anticompetitive actions of telephone companies in the provision of DSL. Because telephone companies do not provide broadband content and do not have any market power in broadband (or narrowband) Internet portals, they have no economic incentive to discriminate against downstream competition. If, on the other hand, competitive concerns exist, regulation of cable modems to require nondiscrimination seems appropriate, because cable companies have significantly greater economic incentive to discriminate against their rivals given their current market power in multichannel video programming. The current asymmetric regulatory treatment by the FCC of cable modems and DSL seems especially curious. Moreover, the FCC's approach does not follow from the goal of regulation, which is to hinder the exercise of anticompetitive market power.

V. Conclusion

Cable firms are positioned to dominate the broadband industry as they have dominated the delivery of multichannel video programming. With control of both the broadband content and the pipes, a large footprint encourages cable firms to discriminate against their unaffiliated content and conduit rivals.

⁵ For a review of FCC policy see Hausman and Sidak (1999) and Robert Crandall and Hausman (2000). Below-cost prices set by the FCC, due to failure to consider the effect of sunk costs, is discussed in Hausman (1997).

To remedy the risks of conduit and content discrimination, regulators should subject any pending mergers to an open-access provision. In particular, the regulatory agencies should require vertically integrated cable firms to afford unaffiliated ISP's equal and nondiscriminatory access to the combined company's cable modem platform. Doing so will ensure that the incumbent cable provider does not evade or retard the advent of open access, will promote investment in the broadband portal market by giving new entrants certain access to the merged company's cable customers, and will limit the cable firm's ability to engage in both conduit and content discrimination.

REFERENCES

- Cable Datacom News*. Phoenix, AZ: Kinetic Strategies, August 1999.
- Crandall, Robert and Hausman, Jerry. "Competition in U.S. Telecommunications Services: Effects of the 1996 Legislation," in S. Peltzman and C. Winston, eds., *Deregulation of network industries*. Washington, DC: Brookings Institution Press, 2000, pp. 73-111.
- FCC News*, "High Speed Services for Internet Services—Subscribership as of June 30, 2000." Washington, DC: Federal Communications Commission, 31 October 2000.
- Hausman, Jerry. "Specification Tests in Econometrics." *Econometrica*, November 1978, 46(6), pp. 1251-71.
- _____. "Valuing the Effect of Regulation on New Services in Telecommunications." *Brookings Papers on Economic Activity*, Microeconomics 1997, pp. 1-38.
- Hausman, Jerry and Sidak, J. Gregory. "A Consumer-Welfare Approach to the Mandatory Unbundling of Telecommunications Networks." *Yale Law Journal*, December 1999, 109(3), pp. 417-505.